comprising an analyte is introduced into a fluidic zone and combined with a magnetic affinity complex to form a magnetic binding complex. The array of microcoils is activated to move the magnetic binding complex to a zone of the fluidic network comprising a coded affinity complex, which in one embodiment, is not magnetic. The magnetic binding complex and the coded affinity complex form a coded sandwich binding complex. The array of microcoils is activated to move the coded sandwich binding complex to a zone of the fluidic network comprising a signal affinity complex, wherein the coded sandwich binding complex and signal affinity complex form a super-binding complex. This transport moves the coded sandwich binding complex away from the unbound coded affinity complex. The microcoils are again activated to move the super-binding complex away from unbound signal affinity complex and to the detection zone, where it is detected, and where detection of the super-binding complex indicates the presence of the analyte.

[0044] A "coded affinity complex" comprises a particle functionally coupled to an affinity agent and a code. It is contemplated that the particle in such a complex may or may not be magnetic.

[0045] A "magnetic binding complex" comprises a magnetic affinity complex and an analyte.

[0046] A "signal binding complex" comprises a signal affinity complex and an analyte.

[0047] A "competitive binding complex" comprises a magnetic affinity complex and a signal analyte complex. A competitive binding complex can be formed using the methods and devices of certain embodiments of the invention. For example, a sample suspected of comprising an analyte is introduced into the sample zone of the fluidic network, wherein a magnetic affinity complex binds to the analyte to form a magnetic binding complex. The microcoil array is activated to move the magnetic binding complex from the sample zone to another fluidic zone. The analyte is displaced from the magnetic binding complex with a signal analyte complex. The combination of the signal analyte complex and the magnetic binding complex forms a competitive binding complex. The signal detected from the signal analyte complex that did not form the competitive binding complex indicates the presence of the analyte. Typically this method is useful for determining the presence of a small molecule, such as, but not limited to, sugars, drugs, steroids, and vitamins. In an alternative binding scheme: a) competitive binding complexes are pre-formed with magnetic affinity complex and analyte-conjugated signal affinity complex, b) the competitive binding complexes are directed to sample zone, where sample analyte displaces analyte-conjugated signal affinity complexes, c) the magnetic binding complexes are moved away from the sample zone by activating the microcoil array, and d) displaced analyte-conjugated signal affinity complex are detected in the sample zone, wherein the signal strength is proportional to the amount of sample analyte.

[0048] A "coded magnetic binding complex" comprises a magnetic affinity complex, an analyte, and a code. A "coded magnetic signal binding complex" comprises a magnetic signal affinity complex, an analyte and a code. Both of these binding complexes can be formed using the methods and devices of certain embodiments of the invention. Typically, a sample suspected of comprising an analyte is introduced into the sample zone of the fluidic device, wherein a coded magnetic affinity complex binds to the analyte to form a coded magnetic binding complex. The microcoil array is activated to move the coded magnetic binding complex from the sample zone to a first affinity surface, where it is bound and immobilized. Typically the affinity agent on the first affinity surface is complementary to and binds to the affinity agent on the magnetic particle. The code is then detached from the coded magnetic binding complex. The detached code then binds to a magnetic signal affinity complex to form a coded magnetic signal binding complex. Typically the affinity agent of the magnetic signal affinity complex is complementary to the code. In one embodiment, the affinity agent of the magnetic signal affinity complex is a polynucleotide complementary to the code polynucleotide. The microcoil array is activated to move the coded magnetic signal binding complex to one or multiple detection zones comprising a second affinity surface. Typically different areas of the detection zone or the different detection zones contain unique affinity agents to the codes. The affinity agents of the second affinity surface are complementary to and bind the code. The detection element then detects the coded magnetic signal binding complex in the detection zone using electrical sensing methods, optical sensing methods, or enzymatic methods, such as amplifying the affinity agent (if it is a polynucleotide) on the magnetic signal affinity complex.

[0049] It is contemplated that the analyte will bind to the affinity agent coupled to the magnetic particle, the signal particle, and/or the affinity surface. "Binds to" refers to the interaction of the analyte with the affinity agent, which is typically a non-covalent interaction. The interaction of the analyte with the affinity agent can be characterized in terms of a binding affinity. Binding affinity can be readily determined using standard technology. For example, the BIAcore™ system (Uppsala, Sweden) is one method for determining binding affinity. The BIAcore™ system uses surface plasmon resonance (SPR, Welford K. 1991, Opt. Quant. Elect. 23:1; Morton and Myszka, 1998, Methods in Enzymology 295: 268) to monitor biomolecular interactions in real time. BIAcore™ analysis conveniently generates association rate constants, dissociation rate constants, equilibrium dissociation constants, and affinity constants. In certain embodiments, the affinity agent binds to the analyte with a binding affinity of at least 10^3 M^{-1}, more preferably at least 10^5 M^{-1}, and still more preferably, at least 10^7 M^{-1}.

[0050] A "substrate" refers to a material or a combination of materials upon and/or within which other or additional materials are formed, attached, or otherwise associated with according to a predetermined fashion. A substrate often provides physical and functional support to the other or additional materials such that, together, they form part or whole of a functional device. A substrate may be a combination of two or more other substrates, which, due to the combination, have become an identifiable new substrate. In the embodiments of the invention, the substrate may comprise metal, silicon, glass, or polymeric materials. In more specific embodiments, the substrate contains an integrated circuitry component, and is functionally coupled to a magnetic microcoil array, a vibration element, a detection element, and/or a circuit board.

[0051] A "microcoil" is a coil, or one or more connected loops, having at least one dimension in the micrometer (μm), or less than 10^{-3} meter (mm), scale. A microcoil usually comprises a thin material wound or gathered around a center or an imaginative center into spiral, helical or other shapes. A microcoil is defined by the material itself, the shape of the windings, and the separation between each windings. Solenoid type microcoils are multiple spiral wire loops, which